UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/821,100	04/07/2004	Zhong Dong	M-15295 US	8965

32605 7590 02/25/2008

MACPHERSON KWOK CHEN & HEID LLP
2033 GATEWAY PLACE
SUITE 400
SAN JOSE, CA 95110

EXAMINER	
VU, DAVID	
ART UNIT	**PAPER NUMBER**
2818	

MAIL DATE	DELIVERY MODE
02/25/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 10/821,100
Filing Date: April 07, 2004
Appellant(s): DONG ET AL.

Gideon Gimlan
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 12/14/07 appealing from the Office action mailed 07/13/07

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

6,706,613	You et al.	03-2004
2005/0110102	Wang et al.	05-2005
2003/0124873	Xing et al.	07-2003

6,830,973	Fujimuto et al.	12-2004

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 11, 26 and 27 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The original disclosure does not include teaching:

a) "ONO-type memory cell stack does not include a metal silicide layer" (**claim 11**);

b) "…flowing the molecular hydrogen (H_2) towards the stack is constrained to below a volumetric flow ratio of H_2 to O_2 at which formation of a hydrogen flame due to the presence of H_2 is at least unstable if not that the flame is extinguish or unignited due to insufficient presence of H_2" (**claim 26**); and

c) "….flowing the molecular hydrogen (H_2) towards the stack is constrained to below a volumetric flow ratio of H_2 to O_2 at which stable ignited of a hydrogen flame due to the presence of H_2 is assured on a mass production basis" (**claim 27**).

Applicants submit that support for claims is found in figure 3A. However, figure 3A and the specification as written do not exclude application of a metal silicide layer to an ONO-type memory cell stack. Also, figure 3A shows hydrogen is applied to ONO structure, but it is not clear how the fig. 3A could support for the limitations "…flowing the molecular hydrogen (H_2)…. is constrained to below a volumetric flow ratio of H_2 to O_2 at which formation of a hydrogen flame due to the presence of H_2 is at least unstable if not that the flame is extinguish or unignited due to insufficient presence of H_2" (**claim 26**); and "….flowing the molecular hydrogen (H_2)……is constrained to below a volumetric flow ratio of H_2 to O_2 at which stable ignited of a hydrogen flame due to the presence of H_2 is assured on a mass production basis" (**claim 27**).

Any response to this 112 rejection should include the location in the original disclosure where the subject matter can be found.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1-15 and 21-24 are rejected under 35 U.S.C. 103 (a) as being unpatentable over You et al. (US Pat. 6,706,613, hereinafter You) in view of Wang et al. (US 2005/0110102, hereinafter Wang).

Regarding claims 1-8, 10,11, 15 and 21-24, You discloses in figs. 2B-2C a method of forming sidewall dielectric on an ONO-type memory cell stack where at least one sidewall of the ONO-type memory cell stack 108 includes a plurality of exposed material layers respectively composed of an oxide 105a and an oxidizable material (nitride layer 106a) disposed adjacent to the oxide 105a, the method comprising subjecting the sidewall 120a to a thermal oxide process to form a sidewall oxide (fig. 2C and col. 5, lines 29-37) and forming an supplemental nitride sidewall dielectric after the rapid oxidation process (col. 7, lines 58-67).

You fails to disclose forming the sidewall oxide layer by hydrogen and oxygen. However, Wang teaches that the sidewall oxide layer is formed by a dry ISSG process at a temperature is about 800-1000°C, the flow rate of H_2+O_2 is about 1slm –40slm {See **[0032]**; **[0038]** and **[0041]**}, the pressure is about 1-20 Torr, the duration is about 30-120 seconds **[0046]**; the ratio of

H_2/H_2+O_2 is in the range about 0.1%-40%, therefore, the ratio H_2: O_2 is about 0.01 (Let x be H_2, y be O_2; x+y = 100% = 1 and x/(x+y) = 0.1; we got x:y = 0.01). It would have been obvious to one with ordinary skill in the art at the time of the invention to form an oxide film by using a dry ISSG process as taught by Wang in the process of You. As recognized by one skilled in the art, a dry ISSG process provides excellent thickness control and the thermal budget can be reduced (Abstract).

Note that the dry ISSG process is often described as a process generates short lived oxygen radicals {See Xing et al. (US 20030124873) ([**0026**]-[**0038**]) for evidence of the state of the art in which atomic oxygen is created by an ISSG process}. Furthermore, the ISSG process of You and Wang meet the structural and methodological limitations of this claim, thus they would (as an obvious consequence) also exhibit the same functional characteristics (i.e. generates short lived oxygen radicals whose reactivity extinguishes before the short lived oxygen radicals are able to permeate as deep into the ONO-type memory cell stack and oxidize materials therein as would the reactive oxygen of a High Temperature Oxidation (HTO) process applied to an essentially same ONO-type memory cell stack).

Regarding claim 9, You discloses exposed material layers of the ONO-type memory cell stack includes: a first silicon nitride layer 106a; a first silicon layer (floating gate 104); and a first silicon oxide layer 105a adjacent to the first silicon layer 104 (fig. 2C).

Regarding claim 12, You and Wang fails to disclose a height variation ratio is about 1.20 or less. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the combined process of You and Wang by selecting a suitable thickness/height ratio in order to achieve a specific sidewall dielectric, since it has been held that

where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges for result effective variables involves only routine skill in the art. In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955). Moreover, the specification contains no disclosure of either the critical nature of the claimed process/device (i.e. - thickness/height ratio) or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen limitations or upon another variable recited in a claim, the Applicant must show that the chosen limitation are critical. *In re Woodruff*, 919 F.2d 1575, 1578 (Fed. Cir. 1990).

Regarding claims 13 and 14, as recognized by one skilled in the art that a larger erase speed is obtained in a memory cell after formation of the sidewall dielectric by the dry ISSG process {See Fujimoto et al. (US Pat. 6,830,973); col. 7, lines 32-38 and Applicants specification, paragraph [**0039**]}. Note that the ISSG process of You and Wang meet the structural and methodological limitations of this claim, thus they would (as an obvious consequence) also exhibit the same functional characteristics.

Allowable Subject Matter

Claims 25 and 28 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

(10) Response to Argument

<u>Response to arguments for Rule 132 Declaration</u>

The arguments in Declaration are the same as the Appellant arguments (Appeal Brief); therefore, they have been treated together. The Declaration is based on the opinion and education of the inventor.

<u>Response to arguments for First §112 Rejection</u>

Appellant argues that the limitation "ONO-type memory cell stack does not include a metal silicide layer" (**claim 11**) is supported by Fig. 3A and "under proper circumstances, drawings alone may provide a 'written description' of an invention as required by § 112." 935 F.2d at 1565, 19 USPQ2d at 1118. Drawings constitute an adequate description if they describe what is claimed and convey to those of skill in the art that the patentee actually invented what is claimed." (*Brief*, page 27). However, no where do the specification (texts and figures) define the ONO memory stack should not include the metal silicide as a part of the memory device. Applicant appears to be merely stating opinion (i.e., "an understanding by those skilled in the art that metal silicide should not be present when hydrogen is being used in the flow gas") but does not provide any objective documentation or teaching in the prior art that this would be the case.

Appellant argues that the limitation "…flowing the molecular hydrogen (H_2) towards the stack is constrained to below a volumetric flow ratio of H_2 to O_2 at which formation of a hydrogen flame due to the presence of H_2 is at least unstable if not that the flame is extinguish or unignited due to insufficient presence of H_2" (**claim 26**); and "….flowing the molecular

hydrogen (H_2) towards the stack is constrained to below a volumetric flow ratio of H_2 to O_2 at which stable ignited of a hydrogen flame due to the presence of H_2 is assured on a mass production basis" (**claim 27**) is supported by paragraph [**0040**] of the specification, which states: "It is outside of conventional, mass-production practice to reduce the H_2/O_2 volumetric flow ratio below this range (more specifically, below 0.3) because the flame may become unstable at lower values of the ratio." As such, claims 26 and 27 based on specification of $H_2/O_2 > 0.3$ appear to contradict independent claim 1 which require $H_2/O_2 <0.2$.

<u>Response to arguments for the obviousness rejection over You in view of Wang.</u>

<u>Independent claims 1 and 23</u>

Appellant argues that the examiner cautions that the You'613 oxidation process must be a dry one, i.e., avoid the use of hydrogen {see *Rule 132* ¶4b-4d, 4m and *Brief*, pages 10&18}. In fact, nowhere in You'613 does the reference teach that the sidewall oxide layer on the ONO stack has to be formed by a dry oxidation process. In fact, the oxide film 116 can be formed by various methods (i.e., using O_2 or a mixture of H_2/O_2 as the oxygen source, or by other methods involving exposing the ONO-type memory cell stack to an oxidant). The use of a dry oxidation process referenced in You'613 is mentioned only as one example of many different processes that could be used to produce the sidewall oxide film (i.e., "for example…"). More importantly, nowhere in '613 does the inventor exclude or preclude the use of a wet oxidation process as a means of forming the sidewall oxide film.

Appellant argues that You‘613 insists on the use of a dry oxidation process for the formation of the sidewall oxide film on the ONO stack (see *Rule 132* ¶4d), but as was previously pointed out by the examiner, the use of the dry oxidation process was used only as an example, not as a limitation for forming the sidewall oxide film of the ONO stack. Appellant further states that it is his opinion that the use of hydrogen would act as a catalyst for the decomposition of the metal silicide layer {see *Rule 132* ¶4e, 4f, 6b and *Brief*, pages 8, 13, 17&18}. However, Appellant does not provide any objective documentation or teaching in the prior art that this would be the case.

Appellant states that examiner's motivation to combine You'613 and Wang'102 is to reduce the Bird's Beak formation, namely the oxide encroachment show in Region “A” of You’s Fig. 1 between the polysilicon control gate 18 and polysilicon floating gate 14 {see *Rule 132* ¶4a,4e, 4i,5f-5h, 5m, 6d and *Brief*, pages 11, 13, 16-18&25}. However, a reduction in Bird’s Beak formation cannot be found in any of applicant’s claims, and furthermore is not the motivation of the Examiner to combine You'613 and Wang'102. Rather, Examiner's motivation to combine You'613 and Wang'102 is rooted in the fact that any generic ISSG process has excellent thickness control and a reduction of thermal budget as inherent properties of the process, regardless of the context in which the process is used. This is evident to any artisan that is skilled in the art. Examiner is not clear as to applicant's reasoning in asserting the reduction in Bird's Beak formation in 4a of the Appellant's Rule 132 as this is not a claimed limitation of the present application, and as is pointed out herein, one skilled in the art would be motivated to combine You‘613 and Wang‘102 to achieve the benefits of excellent thickness control and

reduction in thermal budget of generic ISSG processes for forming an oxide layer in any semiconductor device as an oxide dielectric layer.

Appellant argues that “Wang does not compare his ISSG processes against "dry" oxidation” (*Brief*, pages 10&16).The formation of silicon oxide films is performed by the process of dry oxidation (You) or by the process of wet oxidation (Wang). Both processes were thermally activated, but in wet combustion the necessity to use low temperature relative to those which apply in dry combustion. Therefore, the wet oxidation process taught by Wang will have a reduced thermal budget compared to the dry oxidation processes taught by You due to reduced oxidation temperatures. Moreover, the conventional furnace oxidation process often demands many hours to fabricate a film layer. As recognized by one skilled in the art, during the process of wet oxidation, hydrogen is caused to combust in an oxygen atmosphere while oxidation occurs. The growth rate of the oxide film using wet oxidation is higher than the growth rate that can be achieved using dry oxidation. Wet oxidation is therefore more effective when forming oxide films at low temperatures . As such, the wet ISSG oxidation process has the advantages of fast reaction. Hence, using the ISSG oxidation process can save a lot of processing time as well as production cost.

Appellant argues that in “his professional opinion this statement is technically incorrect and without basis” in referring to the statement that ISSG processes provide excellent thickness control and a reduction in thermal budget (see *Rule 132* ¶4e). As has been previously asserted by the examiner, it is not a requirement for Wang to explicitly state this, as it is well known that these benefits are conferred through the use of ISSG to anyone that is skilled in the art.

Appellant argues that “The FOA challenges Applicant's assertion with regard to the You '613 language: "for example a dry oxidation process" that a person of ordinary skill in the art would interpret this passage to mean that dry (no hydrogen) oxidation must be used. Applicant respectfully re-asserts that, yes, the person of ordinary skill in the art would interpret this passage to mean that dry (no hydrogen) oxidation must be used. This is backed up by evidence, by the submitted Rule 132 Declaration.”(*Brief*, pages 22-24). This arguments are not persuasive. First, You ‘613 merely states "for example a dry oxidation process... ". This does not necessarily mean the oxide film 116 must be made a dry oxidation process, since the oxide film 116 can be formed by various methods (i.e., using O_2 or a mixture of H_2/O_2 as the oxygen source or other methods involving exposing the ONO-type memory cell stack to oxidant). You teaches that dry oxidation process is one the choice of forming the oxide layer 116 (i.e. “for example…” (col. 7, lines 39-40). The fact is that nowhere in the You reference does You teach that other oxidation process beside a dry oxidation process cannot or should not be used for forming the oxide layer 116. In addition, no element or process used in the description of the You ‘613 should be construed as critical or essential to the prior art unless explicitly described as such. Second, no where do the You ‘613 define the process in which the thermal oxidation process is try to avoid using hydrogen. Applicant appears to be merely stating opinion (i.e. “would avoid”). You does not state that hydrogen is prohibited from being used in conjunction with the ONO-type memory stack. Finally, applicant’s argument however, read too much into the language “a dry oxidation process" in You ‘613. It should be noted that the 103(a) rejection is base on the structure of You (the exposed ONO-type memory cell stack) and the process of Wang (ISSG process). In all, the arguments are not persuasive.

Appellant argues that Wang's ISSG processes are not useful for reducing bird's beak because Fig. 6 of Wang shows a large bird's beak structure 634 and would have been guide away from combining Wang with You at least for this reason (see *Brief*, pages 8, 13&17). However, this type of "bird's beak" is known as an isolation structure, which is formed in order to provide an electrical isolation between rows of cells (i.e., the memory cells are separated by an element isolation region such as bird's beak LOCOS or trench isolation). The "bird's beak" of Wang do not exist on the sidewalls of the ONO stack during the oxidation process. Therefore, neither You nor Wang is considered to teach away from the combination of the two references.

Appellant argues that there is a nitride coating that is formed as a result of the "pre-annealing" step of oxide formation{see *Rule 132* ¶4j, 4k, 4l, 6a and *Brief*, pages 9, 14, 15,19 &20}. However, at no point in You'613 does the reference teach or claim the formation of a nitride layer. Thus, applicant's argument that the ONO sidewall would not be exposed due to the presence of such a nitride layer is irrelevant. Further, the exposure of the ONO sidewall prior to the oxidation process is clearly depicted in Fig 2B of You'613.

Appellant argues that "it would be understood by a person skilled in the art that the low end of H2/H2 + O2 range in Wang would not be expected to produce an exothermic flame under conventional pressures, and thus is not recommended." {see *Rule 132* ¶5d, 5e&5l}. In fact, the H2/H2 + O2 range in Wang'102 is 0.01-0.23 and the requirement of the applicant's invention is <0.02. As long as the range that is taught and claimed in Wang '102 meets the requirements of the applicant's claim for this range (< 0.02), there is no exemption from using Wang'102 as a prior art reference with respect to applicant's invention.

Appellant argues that "Wang does not teach or remotely suggest the concept of *shortening* oxygen radical lifetimes by supplying a flow of hydrogen that is insufficient to sustain a stable hydrogen flame." This is not persuasive since the dry ISSG process is often described as a process generates short lived oxygen radicals.

Appellant argues that there is no explicit teaching in Xing '873 to show that the short lifetime of oxygen radicals would be of benefit in dealing with the problem of the Bird' Beak {see *Rule 132* ¶5c, 5d, 5i-k, 6c}. However, the purpose of using Xing '873 is to simply demonstrate that ISSG processes in general generate short lived oxygen radicals; no explicit reference to their use in dealing with the Bird's Beak problem would be necessary to effectively demonstrate this teaching in the prior art.

Appellant argues that the examiner's conclusion of obviousness is based upon improper hindsight reasoning. It must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971). You et al. teaches subjecting the sidewall of the ONO-type memory cell stack to a thermal oxide process to form a sidewall oxide but does not mention the specific details such as the volumetric flow ratio of the H_2: O_2 as recited. Therefore, one of ordinary skilled in the art is motivated to use a known volumetric flow rate such as the rate taught by Wang et al.

Dependent claims

The arguments made with regard to claims 1 and 23 above apply to these dependent claims and the arguments and the rejection they are in support of are considered proper. The dependent claims stand and fall together with the other rejected claims.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Conferees:

/DAVID VU/

Primary Examiner, Art Unit 2818

/Steven Loke/
Supervisory Patent Examiner, Art Unit 2818
Steven H. Loke
Supervisor-AU 2818

/D. A. D./
Drew Dunn A.
TQAS - 2800

MacPherson Kwok Chen & Heid LLP

2033 Gateway Place, Suite #400

San Jose, CA 95110